

Indicator: Trends in Forest Extent, Types, and Age Class (108 & 109)

The forests of the U.S. cover extensive lands in both the eastern and western thirds of the country. Forest lands are managed by a complex array of interests to meet multiple purposes, including providing ecological habitat and timber resources. While the amount of forest land has remained nearly unchanged since the beginning of the 20th century, regional changes both in amount and types of forest cover have occurred as a result of changing patterns of agriculture and development. The distribution of various forest cover types is a critical determinant of the condition of forest ecosystems.

This indicator is based on data from the USDA Forest Service Forest Inventory Analysis (FIA) system. The FIA program, using a statistical survey design and comparable methods across the U.S., collects a variety of data that help assess the extent, type, age, and health of forestland in the United States. Because the surveys are repeated over time, the FIA data provide an indication of trends in the extent of forestland.

What the Data Show

The amount of forest and percentage of forestlands used for timber have remained relatively constant in recent years (Figure 108.1). Overall, FIA reports that the amount of forestland in the U.S. in 2001 was estimated at 749 million acres, a decrease of about 10 million acres from a century ago and 7 million acres half a century ago, but an increase of more than 5 million acres in the last quarter of a century (USDA, *Forest Resources of the United States*, 2002).

EPA Regions vary significantly in the percentage of forestland that is used for timber, with significant acreage of low productivity or reserved forestlands in the Regions of the west (e.g., Regions 8, 9, and 10) and nearly 100 percent of forestland used for timber production in Regions 1, 2, 3, 4, 5, and 7 (Fig 108.2).

Figure 108.3 shows the changes in forestland acreage in the different EPA Regions during the periods 1907-38, 1938-53, 1953-77, and 1977-2001. Between the first and last time periods, forestland acreage declined by roughly 22 million acres in Region 6 (25% of the forestland acreage in the Region in 1907) and more than 12 million acres in Region 9. Over the same period, forestland acreage in Region 3 increased by 13 million acres and in Region 5 by 10 million acres. Forestland acreage in Region 2 nearly doubled in the time frame (USDA, *Forest Resources of the United States*, 2002).

The types of forests that occur in the western and eastern U.S. and acreage change during the period 1992 - 2001 (Fig 108.4). Eastern and western forest lands support different species (these data do not represent all forestland, only timberland as defined by FIA data collection procedures). The largest change in acreage occurred in Maple-Beech-Birch, gaining 438,800 acres since 1992. The acreage of White-Red-Jack Pine and Spruce-Fir both declined by approximately 260,000 acres.

In the west, several species exist in very small areas, including Western Redwood, Larch, and Western White Pine. Redwood and white pine acreage declined 36 and 44 percent respectively, while Fir-Spruce, other softwoods and western hardwoods all increased by significant amounts.

Younger trees (<60 years) dominate in the eastern U.S. and trees older than 60 years dominate in the west (Fig 108.5).

Indicator Limitations

- In 1998, Congress mandated that the FIA be switched from periodic to annual inventories. While the data are collected more often, fewer data are collected. The quality and reliability of national estimates may be reduced, as because area estimates are based on a smaller sample size.
- Data on extent of forest land have an uncertainty of 3 to 10 percent per million acres for data reported since 1953.

Data Sources

USDA Forest Service, Forest Inventory Analysis. <http://www.fia.fs.fed.us/>

Smith, W. Brad, Patrick D. Miles, John S. Vissage, Scott A. Pugh, *Forest Resources of the United States, 2002*, USDA Forest Service. http://ncrs.fs.fed.us/pubs/gtr/gtr_nc241.pdf

USDA Forest Service, *Draft Resources Planning and Assessment Tables*
http://ncrs2.fs.fed.us/4801/fiadb/rpa_table/Draft_RPA_2002_Forest_Resource_Tables.pdf

Graphics

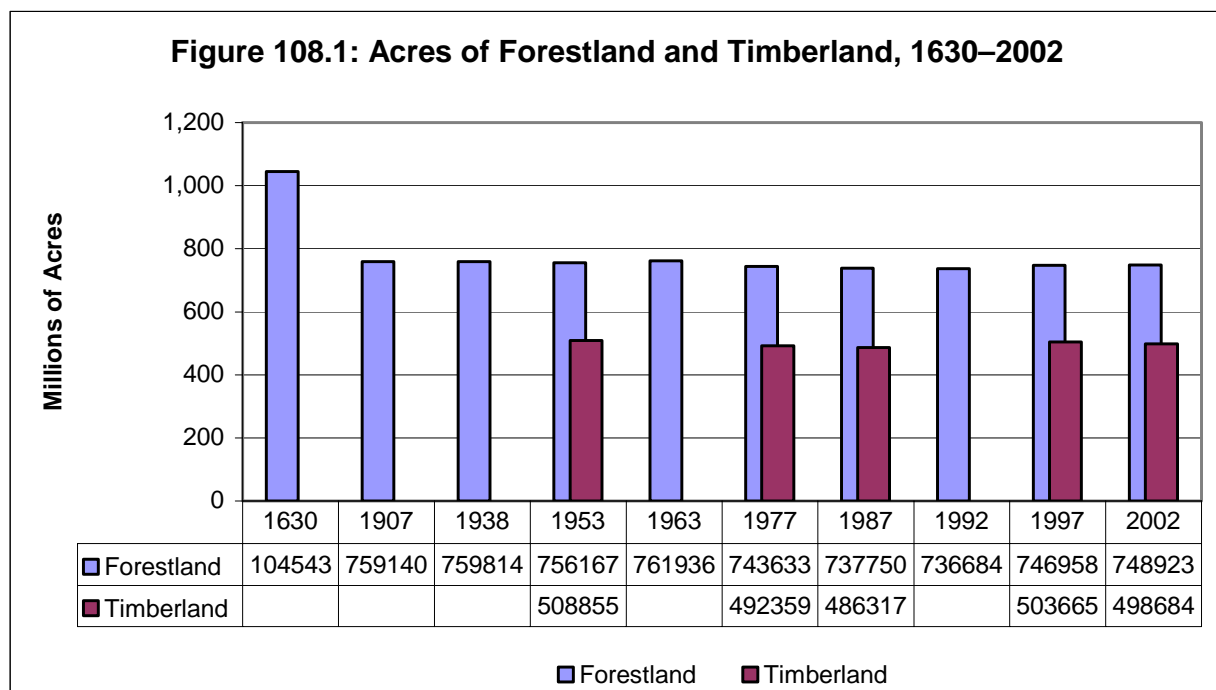


Figure 108.2: Forest and Timber Land by EPA Region 2001

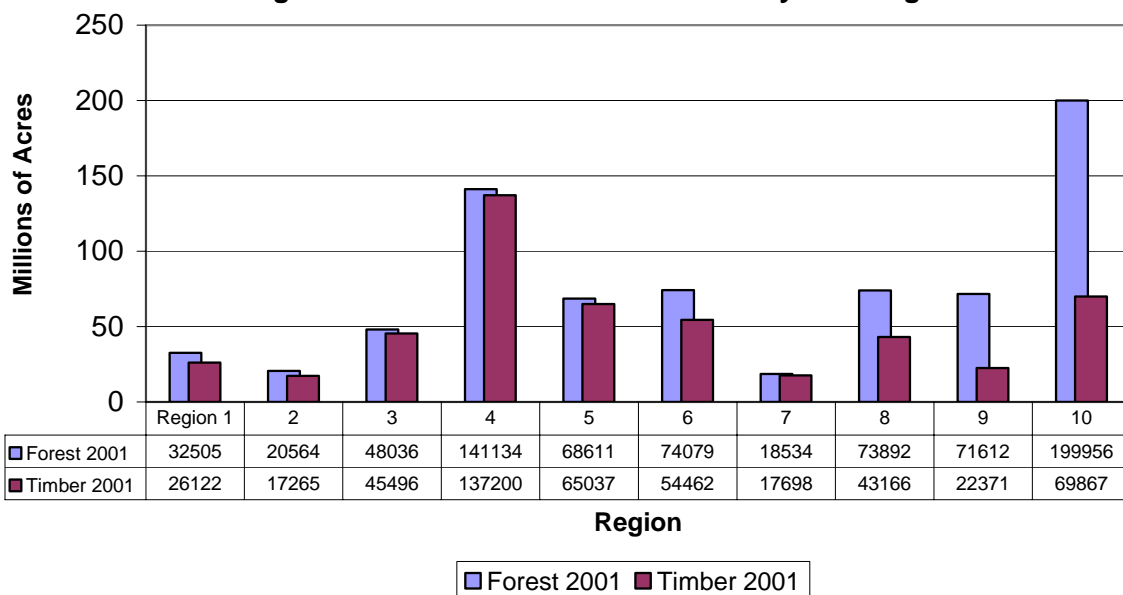


Figure 108.3: Change in Forestland Extent by EPA Region (1907-2002)

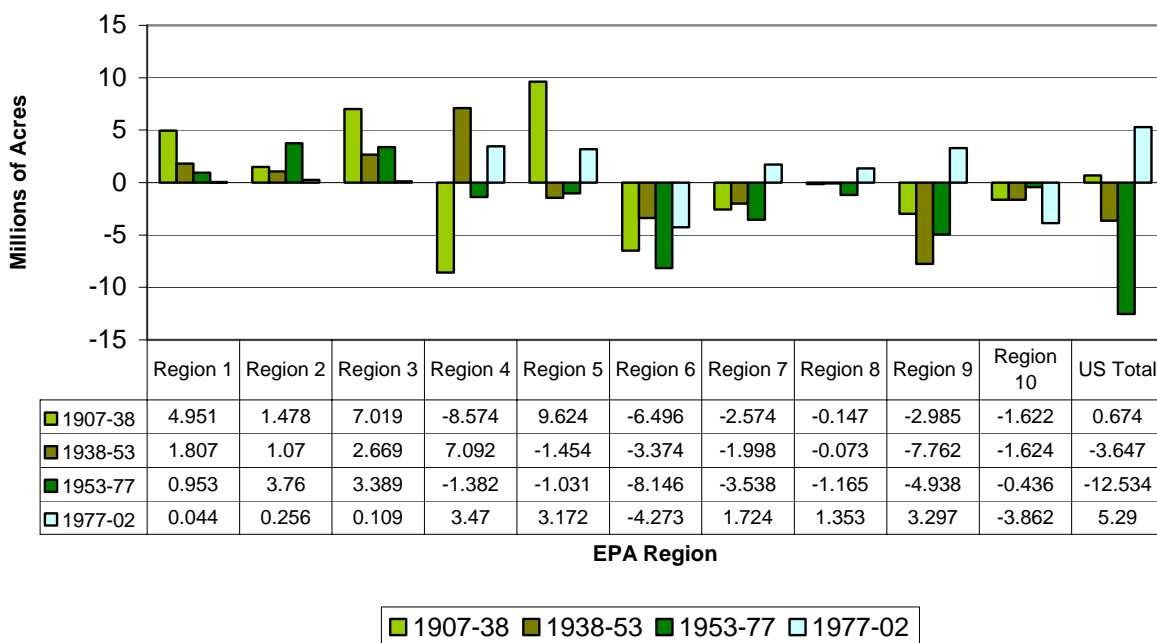


Figure 108.4a: Timberland Area in the Eastern US by Forest Type, 1992–2001

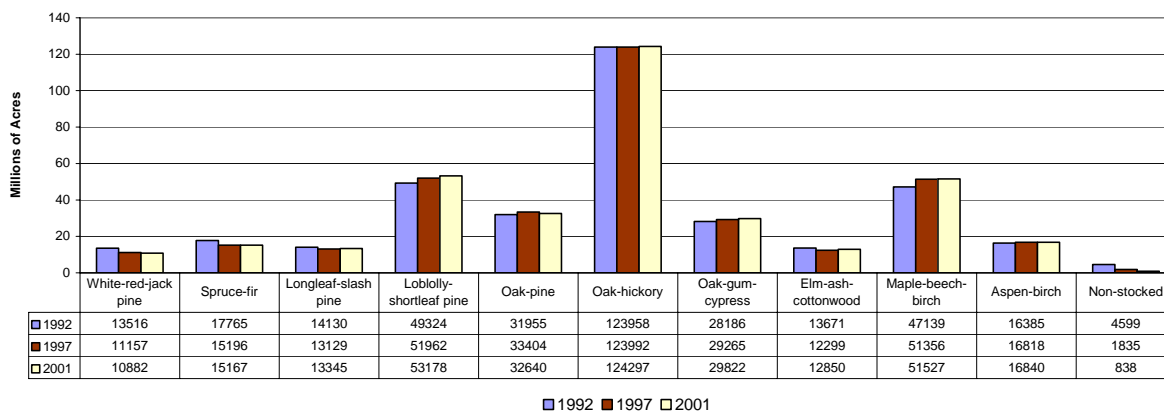


Figure 108.4b: Timberland Area in the Western US by Forest Type, 1992–2001

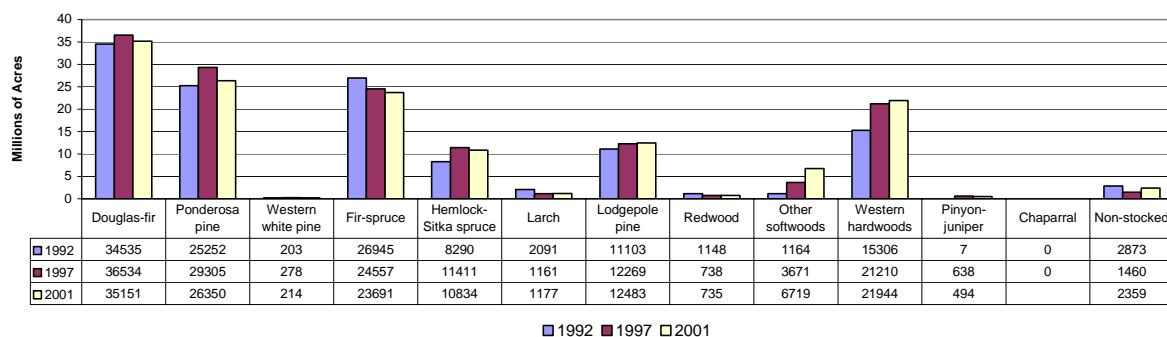


Figure 108.5a: Age Classes of Eastern Timberlands, 1997-2001

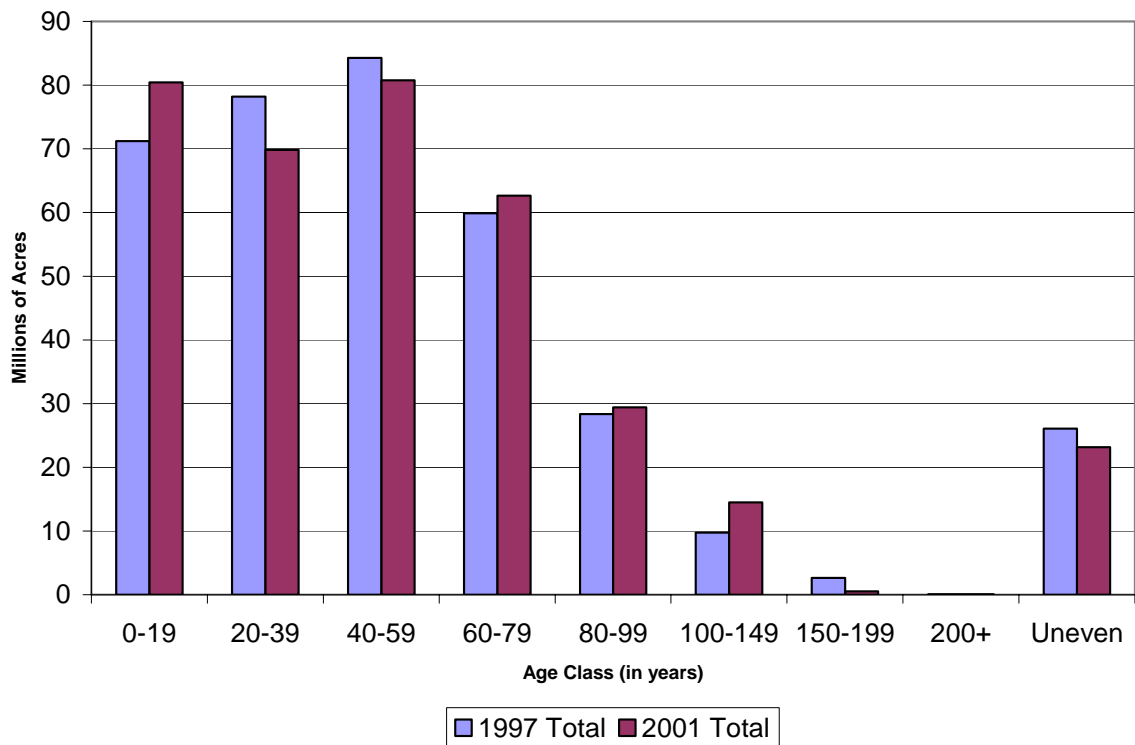
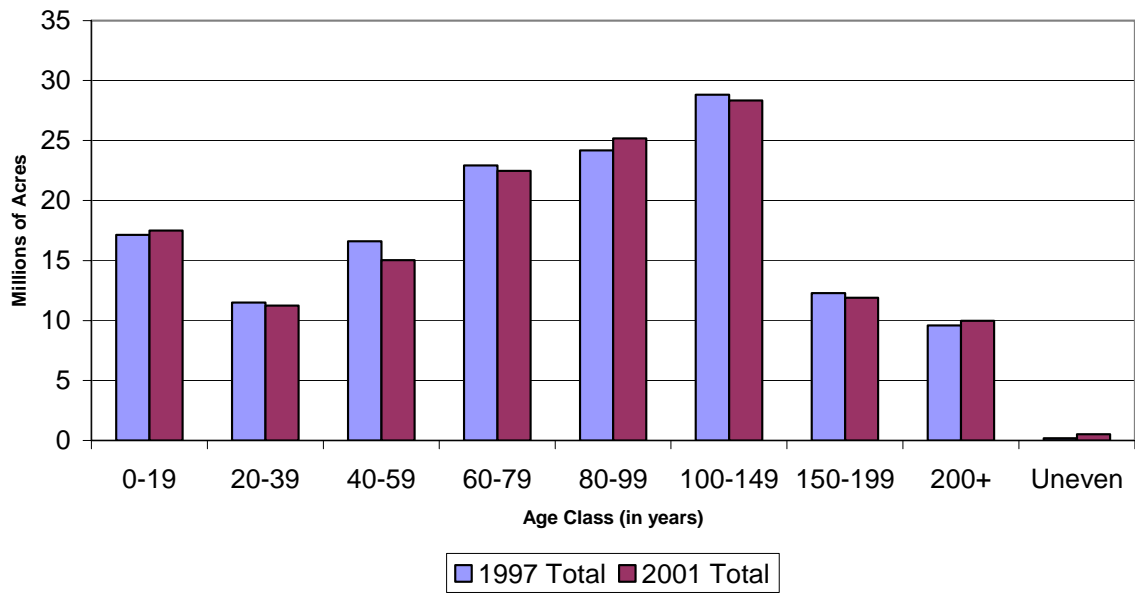


Figure 108.5b: Age Classes of Western Timberlands, 1997-2001



R.O.E. Indicator QA/QC

Data Set Name: FOREST EXTENT AND TYPE

Indicator Number: 108 (89603)

Data Set Source: Forest Inventory Analysis - FIA (USDA USFS)

Data Collection Date: 1982 to present

Data Collection Frequency: some annually

Data Set Description: Forest Extent and Type

Primary ROE Question: What are the trends in land cover and their effects on human health and the environment

Question/Response

T1Q1 Are the physical, chemical, or biological measurements upon which this indicator is based widely accepted as scientifically and technically valid?

Yes. The Forest Inventory Analysis (FIA), the nation's forest census, is the best dataset available from which to establish national and regional trends in the amount, type, and condition of forested land. The annual inventory of forest land allows for acreage estimates, as well as other forest characteristics, to be generated on a yearly basis. The Forest Inventory Analysis (FIA) is the nation's forest census, and is acknowledged as the most reliable dataset from which to establish national and regional trends in the amount, type, and condition of forested land. Data are collected based on a multi-phase sample, as described below. The annual inventory of forest land allows for acreage estimates, as well as other forest characteristics.

T1Q2 Is the sampling design and/or monitoring plan used to collect the data over time and space based on sound scientific principles?

Yes. The FIA uses a double probability sample. Remote sensing imagery or aerial photography is first used to classify land as forest or non-forest, and then sampling sites are chosen on a forest ecosystem data is collected from sampling sites. Phases I and II of the annual FIA inventory allows for estimates of forest cover to be generated, from which patterns and trends in forested land cover acreage and health can be deduced. A detailed discussion of the sampling design can be found at <http://fia.fs.fed.us/program-features/basic-forest-inventory/> and see Smith et al. (2002): http://ncrs.fs.fed.us/pubs/gtr/gtr_nc241.pdf.

T1Q3 Is the conceptual model used to transform these measurements into an indicator widely accepted as a scientifically sound representation of the phenomenon it indicates?

Yes. Phases I and II of the annual FIA inventory allows for estimates of forest cover to be generated, from which patterns and trends in forested land cover acreage and health can be deduced. The FIA does conduct peer review for its analysis products (see <http://fia.fs.fed.us/library/fact-sheets/data-collections/Sampling%20and%20Plot%20Design.pdf>).

T2Q1 To what extent is the indicator sampling design and monitoring plan appropriate for answering the relevant question in the ROE?

FIA consists of a nationally consistent core program which can be enhanced at the regional, state or local level to address special interests. A nationally uniform cell grid has been super-imposed over the set of sample locations, in order to provide a uniform basis for determining the annual set of measurement plots. Within the approximately 750 million acres of forested land in the United States, there are approximately 125,000 permanent sampling plots for the FIA inventory, or one sampling plot for every 6,000 acres of forest identified by Phase I points, which are evaluated for every 240 acres of land in the United States. An FIA plot consists of a cluster of four circular subplots spaced out in a fixed pattern. The plot is designed to provide a sampling frame for all P2 and P3 measurements. Phase I remote sensing activities classify forest based on a photo point which defines land as forested if it has 10% or more coverage by forest. With the federal mandate calling for 20% of plots for each state to be sampled every year, each plot should be sampled every 5 years. At present, this number is closer to every 6-10 years, based on a 10% sampling intensity in western lands and 15% in eastern states. A typical plot usually takes a 2-3 person field crew one full day to complete. These numbers do vary from state to state. The most recent annual inventory is based on 2002 data.

T2Q2 To what extent does the sampling design represent sensitive populations or ecosystems?

To the extent that they are found in the forest population identified by Phase I sampling points. There is no attempt to oversample sensitive sites.

T2Q3 Are there established reference points, thresholds or ranges of values for this indicator that unambiguously reflect the state of the environment?

This indicator simply measures extent – there are no reference points as to what the extent of different forest types should be in the modern landscape.

T3Q1 What documentation clearly and completely describes the underlying sampling and analytical procedures used?

What documentation clearly and completely describes the underlying sampling and analytical procedures used? Several fact sheets published by the Forest Service describe the sampling and analytical procedures used and are available on the FIA Library website (<http://fia.fs.fed.us/library>). Data collection: http://fia.fs.fed.us/library/fact-sheets/data-collections/FIA_Data_Collection.pdf; <http://www.fs.fed.us/ne/fia/methodology/pl.html>. Sampling and Plot Design: http://fia.fs.fed.us/library/fact-sheets/data-collections/Sampling_and_Plot_Design.pdf.

T3Q2 Is the complete data set accessible, including metadata, data-dictionaries and embedded definitions or are there confidentiality issues that may limit accessibility to the complete data set?

Raw data for each state for recent inventory years is available at http://www.ncrs.fs.fed.us/4801/fiadb/fiadb17_dump/fiadb17_dump.htm. The website does point out many things: 1) The annual inventory is several to many years later than the last periodic inventory (depending on the state) so that substantial changes may have occurred to the forest resources during that time. 2) The annual inventory uses a different plot design (fixed plot) than that used by the periodic inventories (variable radius plot). 3) The annual inventory samples all lands whereas some of the periodic inventories did not sample certain lands such as national parks. Forest Inventory Analysis: <http://www.fia.fs.fed.us/>. FIA Data is included in the Forest Resources of the United States, 2002 (http://ncrs.fs.fed.us/pubs/gtr/gtr_nc241.pdf).

T3Q3 Are the descriptions of the study or survey design clear, complete and sufficient to enable the study or survey to be reproduced?

Yes. With adequate funding, personnel, and access to USDA forest service sampling sites, the survey design is clear enough as to allow it to be reproduced.

T3Q4 To what extent are the procedures for quality assurance and quality control of the data documented and accessible?

QA/QC is made available in several USDA Forest Service publications, both at the national and region levels (<http://fia.fs.fed.us/library/fact-sheets/data-collections/QA.pdf>). QA/QC results for the Northeast region are available at <http://www.fs.fed.us/ne/fia/methodology/p2/NEQAresults/index.html>.

T4Q1 Have appropriate statistical methods been used to generalize or portray data beyond the time or spatial locations where measurements were made (e.g., statistical survey inference, no generalization is possible)?

Yes. Of the approximately 125,000 permanent sampling plots located in the United States, approximately 10-15% are sampled each inventory year. Sampling for FIA Phase II inventory estimates is cyclical, so every sampling plot is measured every 7-10 years, with USDA Forest Service hoping to reduce this to every five years, once the sample size reaches the Congress mandated 20%.

T4Q2 Are uncertainty measurements or estimates available for the indicator and/or the underlying data set?

Inventories conducted by FIA are designed to meet the following statistical guidelines for accuracy within one standard deviation at the 67 percent level for each State: ± 3 -5 percent per million acres of timberland ± 10 percent per million acres of all other forestland. Region totals generally have errors of less than ± 2 percent. Smith, WB; Miles, PD; Vissage, JS; and SA Pugh. 2004. Forest Resources of the United States, 2002. USDA Forest Service, North Central Forest Experiment Station. Appendix C.

http://ncrs.fs.fed.us/pubs/gtr/gtr_nc241.pdf (p. 30);
<http://www.fs.fed.us/ne/fia/methodology/p2/design4.html>.

T4Q3 Do the uncertainty and variability impact the conclusions that can be inferred from the data and the utility of the indicator?

While a change in methodology/sampling since 1998 results in different reliability levels for state by state forest inventory data, FIA is still the best inventory of forest in the United States, even with the change in sampling procedure. The comprehensive sampling and monitoring design ensures that statistically reliable data is generated.

T4Q4 Are there limitations, or gaps in the data that may mislead a user about fundamental trends in the indicator over space or time period for which data are available?

In 1998, Congress mandated that the FIA be switched from periodic to annual inventories. While the data is collected more often, less data is collected. So, the quality and reliability of national estimates has reduced, as it is based on a smaller sample size. So, comparing pre and post-1998 data presents some issues of differing reliability and accuracy. However, improvements in satellite imagery have resulted in higher resolution imagery from which to determine and classify forest cover for Phase I estimates.